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PATENT CLAIMS

1. A process for producing polyesters or copolyesters by esterification of dicarboxylic acids and diols or by re-esterification of dicarboxylic acid esters and diols in multiple reaction stages, precondensation of the esterification/re-esterification product in at least one reaction stage and polycondensation of the precondensation product in at least one reaction stage by setting the pressure in the precondensation stage and in the polycondensation stage to be in the range of 0.2 to 500 mbar and setting the temperature at 230° to 330°C, condensing the vapors formed in precondensation and polycondensation in a condensation stage and recycling the resulting cooled diol back to the condensation stage and removing excess diol and sending it back to the process,
characterized in that
circulating cooled diol is sprayed into the vapors introduced into the area at the head of a bottomless direct-contact condenser (4) which is submerged at its foot end (6) into the upper funnel-shaped section (9, 10) of a barometrically submerged downpipe (11), forming an annular space (7) that is closed at the top, said cooled diol being sprayed out of the openings (13, 14) at the edges of spray nozzles (17, 18) situated on at least two planes one above the other in the area at the head end; the vapor residues are discharged through the annular space formed between the wall of the direct-contact condenser and the wall of the section of the downpipe that widens in the shape of a funnel; the fine lumps of polymer aggregates formed in the direct-contact condenser are flushed together with the diol into the downpipe and are removed from the condensation stage.

2. The process according to claim 1,

characterized in that
the average droplet diameter d_s of the sprayed diol, determined according to Sauter, is in the range of 0.5 to 2.5 mm.

3. The process according to any one of claims 1 and 2, characterized in that
the average droplet flight time of the sprayed diol is 0.05 to 0.5 sec.

4. The process according to any one of claims 1 through 3,
characterized in that
the vapor residues discharged from the direct-contact condenser (4) are compressed to a higher pressure and are proportionately condensed further.

5. The process according to any one of claims 1 through 4,
characterized in that
the fine lumps of polymer aggregates in the submerged tank (28) of the downpipe (11) are separated by screening and/or are discharged from the submerged tank (28) together with the excess diol.

6. The process according to any one of claims 1 through 5,
characterized in that
the inside wall of the direct-contact condenser (4) is wetted completely with a trickle film of recycled diol to form a self-contained film.

7. A device for continuous production of polyesters or copolyesters by esterification of dicarboxylic acids and diols or by re-esterification of dicarboxylic acid esters and diols in multiple reaction stages, precondensation of the esterification/re-esterifica-

tion product in at least one reaction stage and polycondensation of the precondensation product in at least one reaction stage by setting the pressure in the precondensation stage and in the polycondensation stage to be in the range of 0.2 to 500 mbar and the temperature in the range of 230° to 330°C; the vapors formed in precondensation and polycondensation are condensed in a condensation stage and the resulting diol is cooled and recycled back to the condensation stage and excess diol is discharged and sent to the process, whereby circulating cooled diol is sprayed into the vapors introduced into the area at the head end of a bottomless direct-contact condenser (4) which is immersed at its foot area (6) forming a section (12) of a barometrically submerged downpipe (11) that is widened like a funnel at the upper end, forming an annular space (7) that is closed at the top, said vapors being sprayed out of openings (13, 14) in spray nozzles (17, 18) at the edge on at least two planes, one above the other in the area at the head end; the vapor residues are discharged through the annular space formed between the wall of the direct-contact condenser and the wall (9) of the section of the downpipe that widens in the shape of a funnel; the fine lumps of polymer aggregates formed in the direct-contact condenser are flushed with the diol into the downpipe and removed from the condensation stage, characterized in that
the openings (13) in the spray nozzles (17) in one plane are arranged on the circumference of the direct-contact condenser (4) so that they are offset with respect to the openings (14) in the spray nozzles (18) in the neighboring plane.

8. The device according to claim 7,
characterized in that

the spray patterns formed by the spray nozzles are in the shape of a solid cone having an angle of divergence of 60° to 140°.

9. The device according to claim 8,
characterized in that
the solid cones formed by the spray nozzles (13) in the upper plane at the head end form an angle of divergence in the range of 60° to 120° and the solid cones formed by the spray nozzles (14) in the plane beneath that have an angle of divergence in the range of 100° to 140°.

10. The device according to any one of claims 7 through 9,
characterized in that
the axes (19, 20) of the solid cones formed by the spray nozzles (13, 14) intersect the vertical axis (21) of the direct-contact condenser (4) at an angle in the range of 5° to 75°.

11. The device according to claim 10,
characterized in that
the axes (19) of the solid cones formed by the spray nozzles (13) situated in the upper plane on the head end intersect the vertical axis (21) of the direct-contact condenser (4) at an angle in the range of 5° to 60°, and the axes (20) of the solid cones formed by the spray nozzles (18) in the plane below that intersect the vertical axis of the direct-contact condenser at an angle in the range of 50° to 75°.

12. The device according to any one of claims 7 through 11,
characterized in that
the spray nozzles (17, 18) have the spray pattern of a circular solid cone.

13. The device according to any one of claims 7 through 11,
characterized in that
the spray nozzles (17) arranged in a plane at the head end have the spray pattern of a rectangular solid cone.

14. The device according to any one of claims 7 through 13,
characterized in that
a liquid pressure nozzle (24), preferably a misting nozzle, for atomizing fresh diol into the introduced vapors with the atomization pattern of a circular hollow cone with an angle of divergence in the range of 15° to 45° is mounted in the curved area of the vapor line (2) to the direct-contact condenser (4) upstream from the pipe mouth.

15. The device according to claim 14,
characterized in that
the axis of the atomization pattern of the hollow cone is aligned approximately coaxially with the axis of the direct-contact condenser.

16. The device according to any one of claims 7 through 15,
characterized in that
at least three openings (13, 14) of spray nozzles (17, 18) are provided in each of the planes into which recycled diol is sprayed, and the openings in the spray nozzles in one plane are arranged at an offset with respect to those of the second plane as seen from above, each offset by half the central angle between two neighboring spray nozzles in one plane.

17. The device according to any one of claims 7 through 16,

characterized in that
the cover (3) of the direct-contact condenser (4) and the vapor tube (2) arranged in the inlet opening of the cover are heatable.

18. The device according to any one of claims 7 and 17, characterized in that
the spray nozzles (17) in the top plane on the head end are positioned in the cover (3) of the direct-contact condenser (4), preferably with thermal insulation.

19. The device according to any one of claims 7 through 18, characterized in that
the spray nozzles (17, 18) and/or the liquid pressure nozzle (24) are mounted above a lance and/or a valve.

20. The device according to any one of claims 7 and 19, characterized in that
the end of the vapor tube (2) arranged in the cover (3) of the direct-contact condenser (4) protrudes beyond the inside wall of the cover and has a sharp drip edge (27).

21. The device according to any one of claims 7 through 19, characterized in that
the inside wall of the cover (3) of the direct-contact condenser (4) has a ring running concentrically outside of the vapor tube (2) as the drip edge.

22. The device according to any one of claims 7 through 21, characterized in that
the edge of the direct-contact condenser (4) on the foot end has a recess (30) diametrically opposite the

drain line (26) for the vapor residues out of the annular space (7).

23. The device according to any one of claims 7 through 21,
characterized in that
the edge of the direct-contact condenser (4) at the foot end is provided with sawtooth profiles either entirely or in sections.

24. The device according to any one of claims 6 through 23,
characterized in that
a peripheral ring nozzle is arranged on the inside of the direct-contact condenser (4) in the upper cylindrical edge area.

25. The device according to any one of claims 7 through 24,
characterized in that
a collecting device (29), preferably a screen basket, for the fine lumps of polymer aggregates washed out with the diol, is arranged in the submerged container (28) of the downpipe (11).